TOBACCO GROWING IN CANADA

BY

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TOBACCO DIVISION,
DOMINION EXPERIMENTAL FARMS

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INTRODUCTION

Almost twenty years have elapsed since Bulletin No. 25, Second Series, dealing with the subject "Tobacco Growing in Canada" was published. Since then, however, the industry has witnessed a considerable change. The advice and recommendations which it contained have become, to a large measure, obsolete and consequently its value to the grower and general public has disappeared. Although it is now out of print requests for it are being received constantly and a complete revision, therefore, was deemed advisable.

In the present bulletin an attempt is made to deal with the more important phases of tobacco production. Such subjects as types of seed-beds, cultural practices, methods of harvesting and curing, diseases and insects are discussed in a simple manner. No attempt is made to deal exhaustively with these or related problems. It is intended to meet only the requirements of those desiring general information and to provide them with the results obtained from recent experimental work throughout the Dominion.

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TABLE OF CONTENTS

Tobacco Growing in Canada

By N. A. MacRae, B.A., M.Sc.

HISTORICAL

The history of tobacco growing in Canada reaches back into the early French colonial days. The French settlers on the banks of the St. Lawrence found the custom of tobacco smoking to be general among the natives. For some years very few of the whites acquired the habit, partly because of governmental opposition. Eventually, however, the practice became general and the farmers began growing the plant; but it was not until about 1735 that the government actually encouraged tobacco growing in Canada. About that time the home government in France endeavoured to utilize the Canadian product. From that time until the conquest, efforts were made to improve the quality of the Canadian product for export purposes, but with little success. The domestic product was extensively used, nevertheless, and under the protection of import duties largely replaced the imported leaf.

Tobacco growing continued under the British rule. With the settlement of what is now Ontario, the tobacco area was extended into the present growing districts. It is probable that the United Empire Loyalists, who settled in Canada following the American Revolution of 1770, brought seed from the tobacco districts in the south. There are records of shipments of tobacco from Essex County, Ontario, shortly after the war of 1812-14. The leaf was sent down the Mississippi to New Orleans. In 1871, four years after Confederation, the first decennial census of the Dominion showed that 399,870 pounds were grown in Ontario, and 1,195,345 pounds in Quebec. Production continued to expand slowly until in 1901 a total of 11,267,000 pounds was grown, and in 1911, 17,632,000 pounds. Production reached its peak in 1932 with a crop of 54 million pounds. Protective duties on imported leaf were imposed in 1897 and from time to time were increased. These duties together with the preference on Empire-grown leaf granted by the British Government in 1918 have played an important part in stimulating the culture of the plant in Canada.

TYPES AND VARIETIES

The tobacco grown in Canada at the present time consists mainly of the types and varieties grown in the United States. An exception to this is found in the pipe tobaccos produced in the province of Quebec. These comprise a somewhat heterogeneous group of varieties, the origin of some reaching back into the days of the French régime in Canada, while the seed of others was brought from Europe more recently. The types and principal varieties are as follows:—

Flue-cured—Bonanza, Yellow Mammoth, Virginia Bright, White Stem Willow Leaf, Gold Tip, White Stem Orinoco, Jamaica, and Warne.

Burley—Judy's Pride, Halley's Special, Kelley Standup White Burley, Standup Resistant, Station Standup, and Harrow Velvet.

Dark air and Dark fire cured—Greenwood, Little Crittenden, Rudolph Improved, Little Hill, Improved Yellow Mammoth, and One Sucker.

Cigar—Comstock Spanish, Connecticut Havana 38, and Resistant Havana.

Large Pipe—Belge 3007, Little Dutch, Parfum d'Italie, and Obourg Vincent.

Small Pipe—Petit Havane and Canelle.

Other varieties have been and are grown, but the above list includes all those grown to any extent. The most widely grown are listed first in each case. Attempts have been made to produce tobacco of the Turkish type, but have met with little success.

The individual characteristics of the above types make them particularly desirable in the manufacture of specific products. The quality, flavour, and aroma of the cured leaf determine its use which, in general, is presented below:—

Flue-cured tobacco for cigarettes, pipe mixtures and plugs.

Burley tobacco for cigarettes, pipe mixtures, twists and plugs.

Dark tobacco for plugs, black twist and snuff.

Cigar leaf tobacco for cigar binders and fillers.

Pipe tobacco for pipe mixtures, cigar fillers, French twist and raw leaf smoking.

AREAS AND PRODUCTION

Although tobacco is grown in practically every province in the Dominion the principal areas of commercial production are located in Ontario and Quebec, with a smaller region in British Columbia. The Ontario district extends along the tier of counties bordering on Lake Erie, including Essex, Kent, Elgin, Norfolk and a small acreage in Brant and Oxford. In years of heavy production the counties of Lambton, Middlesex, Haldimand, Welland, Lincoln, and Prince Edward have been included in the tobacco belt. It is in Ontario that the bright flue-cured, Burley and dark tobaccos are grown. A wide variety of soil types occurs. The light sands and sandy loams of Norfolk, Oxford, Elgin and parts of Essex and Brant produce the bright flue-cured cigarette and pipe tobacco. On the gravelly loams in the southern part of Kent is grown the light coloured thin Burley for cigarettes. In the north and west of Essex, the northern part of Kent and in central Elgin are found the heavier loams producing dark air and fire-cured varieties and heavy red export Burley.

The Quebec districts produce cigar binders and fillers and pipe tobaccos. To the south of Montreal along the valley of the Yamaska River and centered in Rouville County is the region producing some of the finest cigar binders. The soil varies from a dark sand on the river flats to a light loam on the higher land. North of Montreal the counties of l'Assomption, Montcalm, Berthier, and Joliette produce cigar leaf and pipe tobaccos on light sand, or gravel, and loam soils. The tobacco industry in British Columbia is at present centered in the Sumas district in the Lower Fraser Valley and in the vicinity of Kelowna in the Okanagan Valley. Bright flue-cured is produced in the Sumas and Burley in the Okanagan Valley.

The development of the New Belt of Ontario (Norfolk-Oxford-Elgin) has been phenomenal. In 1924 there were but 30 acres under cultivation in that area. The falling off in the dark types has been noticeable in recent years due to a decreased overseas demand. Burley production is subject to recurring periods of over-production. It is grown largely as a cash crop on general farms and the many growers take up and drop its culture depending on fluctuations in the farm price. Until recently, the production of cigar leaf has been remarkably uniform regardless of farm prices. In 1934, however, climatic conditions and a market shrinkage resulted in a 40 per cent drop in production.

CLIMATE, SOILS AND FERTILIZERS

Although the tobacco plant is a native of the tropics its cultivation is widespread. Many countries having a temperate or semi-tropical climate are producing types of tobacco peculiar to local conditions and environment. In the

colder belts where winters are severe a frost-free period of 100-125 days is essential and as tobacco is a heat-loving plant long, warm, bright days are necessary during the growing season for proper development and ripening.

The first requirement of a soil type is that of tilth and friability. Natural fertility should only be secondary in significance as it is more important to grow the crop on a soil that is workable, and easily lends itself to cultivation. Such a soil contains from sixty to eighty per cent sand. On the other hand it should contain sufficient clay and humus for the retention of moisture. Only soils with good surface and under-drainage should be selected. Cold-bottomed soils should be avoided. Low lands and stiff clays are also unsuitable. In general it may be stated that the soil type is reflected in the quality of the crop. Light soils produce a mild bright leaf and heavy soils a dark heavy leaf. A southern exposure as well as protection against prevailing winds are also desirable features.

Fertilizer was not applied to the centre row. Growth and development, as a consequence were retarded.

Flue-cured tobacco has given best results on very light sandy soils, low in natural fertility and organic matter with a standard application of 800-1000 pounds per acre of a 3-10-6, or a 2-10-8 fertilizer on the more fertile soils.

Satisfactory Burley soils may contain twice as much organic matter as required for flue-cured tobacco as well as from 5 to 10 per cent more silt and clay. Burley requires about 1,000 pounds per acre of a 4-8-6 or a 4-8-10 fertilizer.

Desirable quality in dark tobacco can only be obtained on soils slightly heavier than Burley soils. A higher percentage of silt and clay is desirable. The fertilizer requirements, however are similar to those of Burley.

The cigar and pipe varieties require soils of a higher nitrogen and potash content. Natural fertility and organic matter are two features desired in the soils for the production of good pipe and cigar leaf. Best results have been obtained in gravelly loams and river soils. In addition to 10 tons of barnyard manure per acre one ton of a 4-5-5 commercial mixture or 1,000 to 1,500 pounds of a 5-8-7, has been found to be quite satisfactory.

SEED-BEDS

In Canada the growing season for tobacco is usually of relatively short duration, and a few days lost due to under-development of seedlings may result in a crop harvested in an immature or frost-bitten condition. Great stress must therefore be laid on the subject of the seed-bed, and the detailed work of producing seedlings is of paramount importance. A plentiful supply of strong, upright, healthy plants is essential to the production of a first class tobacco crop. Weak, spindly, small-rooted seedlings should not be transplanted to the field.

A. Types

Types of tobacco seed-beds in use in various parts of Canada at the present time are as follows:—

"A-shaped" Bed or Greenhouse.—Used largely in the flue districts of Southwestern Ontario and British Columbia.

Glass-covered Cold Beds.—Used mainly in Quebec cigar districts.

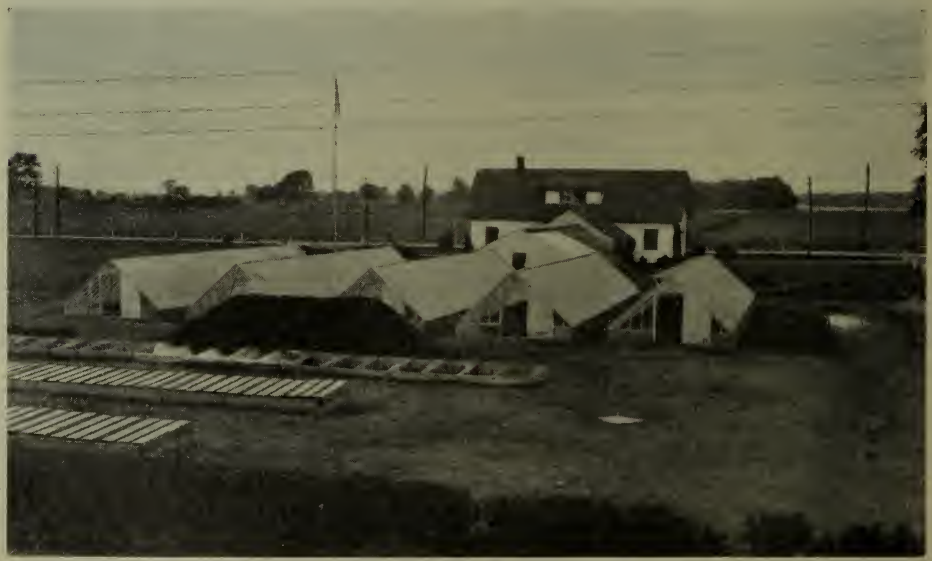
Semi-hot Bed.—Used to some extent for production of cigar leaf in Quebec and Burley in British Columbia.

Canvas or Cotton-covered Bed.—Used mainly in the Burley and dark-fired districts of Southwestern Ontario.

Irrespective of type, in general it requires from 100 to 125 square feet of seed-bed to produce plants sufficient for one acre of tobacco.

(1) "A-shaped" Bed and Greenhouse

Both of these are permanent structures, the latter being so common a construction all over the country that it is not necessary to go into detail concerning it here. For the growing of tobacco seedlings, the greenhouses used are usually medium-sized structures ventilated in the customary manner.



Two types of seed-beds are shown, semi-hot and A-shaped. Note the pile of compost ready for use.

The "A-shaped" bed, while not being really a greenhouse, is of a somewhat similar design. It consists essentially of two long, narrow beds separated by a central walk or pathway, the whole being covered with an A-shaped glass roof. The south end is of glass, the north of wood. Doors open into the central walk from both ends. The entire house is ventilated by means of hinged sashes in the roof. The sides of the A-shaped roof rest on a concrete foundation which extends to a height of 1½ feet above ground level. The roof peak is braced to the foundation by iron piping. The rafters are reinforced by piping running lengthwise and on columns and cross-ties every 8 feet, as well as resting on the concrete foundation. The dimensions of one type of A-shaped bed which has proved very satisfactory are as follows: length 50 feet; width 14 feet; bed width 5½ feet; pathway width 2 feet; concrete foundation above ground 1½ feet and to below ground 3½ feet; door width 3⅓ feet; surface of bed 5 inches above outside ground level.

(2) Glass-Covered Cold Bed

A site for these beds should be well drained and sheltered from northern exposure. The wooden frame supporting the sash should preferably be about 5 feet wide, with sides 12 and 18 inches high respectively, giving a slope of about one inch to every foot toward the south. The frames are collapsible, since they must be dismantled in the fall, being held in place by hooks and small bolts. Cross beams give rigidity to the structure as well as support to the sash. The frame is filled to a height of four or five inches with good compost soil. The sashes should be clamped down on top of the bed in windy weather. These glass frames or sashes are slid up and down to provide ventilation. For shading the young seedlings from the hot sun, canvas covers of the same dimensions as the bed are used. These covers are clamped down by means of cross-boards which hold the sash in place. When not in use the canvas is rolled up and stored near the beds.

(3) Semi-hot Bed

Essentially, this is the same as a glass-covered cold bed, except that the soil instead of being placed directly on the ground inside the frame, is placed on top of a thin layer of manure. The moderate fermentation taking place in the manure causes heat to be generated which warms the seed-bed soil. The layer of manure—usually horse manure—should not be more than 3 or 4 inches deep.

(4) Canvas-covered Semi-hot Bed

This type is similar in general construction and method of erection to the ordinary semi-hot bed, with the exception that the glass-covered sashes are replaced by canvas. Seed-beds with the canvas covering do not force the plants as rapidly as those covered with glass and can only be used to advantage under favourable conditions.

B. Sterilization of Seed-beds

The yearly sterilization of seed-beds is found to be very beneficial in the production of early, vigorous, healthy seedlings. The principal reasons for soil sterilization are concerned with the destruction of soil-borne plant diseases, weed seeds, and in some cases, certain insects. At the same time, sterilization ordinarily has the effect of increasing soil fertility by producing conditions more generally favourable to plant growth.

Various types of heat and chemical treatments for sterilizing the soil have been tested, but as yet none has proved so efficient and reliable as sterilization by steam. From experiments conducted, the inverted-pan method of steaming is found to be most satisfactory. This method is becoming generally adopted in most districts. The full benefits derived from steaming the soil depend on

the thoroughness of the operation. An efficient job depends on three factors: (1) condition of the soil at time of steaming, (2) length of time the soil is exposed to the steam, (3) the pressure on the boiler as well as the flow of steam to the pan. For best results the soil should be moist enough to handle well under ordinary spading conditions. This means that the frost must be out of the ground. It is a poor policy to work or try to steam soil that is too wet. Steam cannot penetrate readily through such soil. On the other hand, the soil should not be too dry, since weeds and parasites are less readily killed in a dry dormant state.

The time required for efficient sterilization is thirty minutes. The tendency in some cases is to rush the job and cut down the steaming to periods of fifteen or twenty minutes regardless of conditions. This often has led to very unsatisfactory results. The soil is a very poor conductor of heat and, as a consequence, it requires considerable time to thoroughly heat the soil at a depth of six to twelve inches. In order to raise the heat under the pan to a point of boiling water, and hold it at this temperature to sterilize the soil to the desired depth, the steam boiler should be capable of maintaining at least 100 pounds pressure.

Formalin sterilization, too frequently is done poorly. At its best it does not kill all weed seeds in the bed. The treatment consists of sprinkling the bed with a solution of 1 part formalin to 50 parts water, at the rate of one gallon of the solution to two square feet of bed space. Two applications should be given 24 hours apart. The beds should be well covered with bags to keep in the fumes. These should be removed 24 hours after the last application and the soil should be loosened well to permit the escape of the formalin fumes before sowing.

In addition to sterilizing the soil it is a good practice to treat the cotton, sash, and framework of the plantbeds or greenhouses. In case the cotton is used the second year it can be sterilized by boiling. The other equipment may

Efficient sterilization of seed-bed soil eliminates disease. Note the difference between "A" and "B", steamed and unsteamed, respectively.

be treated by spraying or dressing with formalin (1 part formalin to 25 parts of water). In order to get the full effect from the formalin fumes all material should be covered and the greenhouse closed tightly. This tends to destroy over-wintering diseases that may otherwise be transmitted to the sterilized soil after steaming

The following diseases affecting tobacco may be harboured in the soil or on the cotton, sash, and frame-work of the plantbed or greenhouse: damping-off or bed-rot, black root-rot, mosaic, and certain leaf-spot diseases. Some of these diseases may not affect the tobacco plants to any visible extent in the plant-bed; but, at the same time, if transmitted to the field, serious damage often occurs. Incidentally, prevention is much more effective than control in the case of these diseases. In most cases the tobacco plantbed is found to be the chief source of contamination.

C. Rates of Seeding

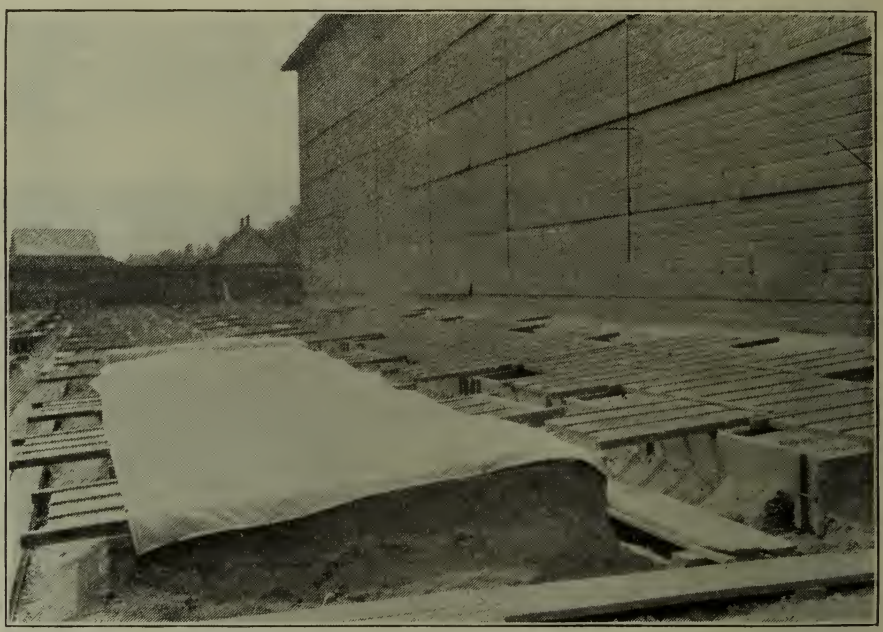
High-germinating tobacco seed is of prime importance in producing a good stand of plants. Difficulties reported by growers in obtaining a satisfactory stand generally reflect back to seed without a known germination test or seed testing less than 70 per cent. Good seed should germinate 80 per cent or higher. Seed with a known germination percentage prevents over-seeding or under-seeding in the plant-beds.

Good seed sown at the rate of 1/12 of an ounce per 100 square feet has given satisfactory results.

The rate of seeding should depend on the germination of the seed, method of seeding, system of watering, and type of bed. Satisfactory results have been obtained by seeding one ounce to 900 or 1,000 square feet in ordinary glass-covered or cotton-covered plant-beds. On the other hand, one ounce sown over 1,000 to 1,400 square feet in A-shaped plant-beds or greenhouses is sufficient. These recommendations are based on high-germinating seed (80 per cent or more) sown dry. If the seed is sprouted before sowing it is usually necessary to sow the seed somewhat thicker. Sowing dry seed with sifted wood ashes, or sand is recommended because nothing is gained by sprouting seed before sowing. Experiments have shown that dry seed will produce seedlings of a transplantable size at just as early a date as sprouted seed.

D. Care of the Beds

Success or failure in the production of strong healthy tobacco seedlings usually depends on the first two weeks' period after the seed is sown. At this time careful regulation of both temperature and humidity is very important. Special care should be taken not to allow the beds to become too dry, especially when the plants are just coming up. Patchy, poor stands usually result, if the beds are allowed to dry out at that stage of growth. Sufficient water should be applied to keep the surface moist. Therefore, frequent light waterings must be applied during the germinating period and until the young seedlings become established. On the other hand, the soil should not be allowed to remain for any length of time in a stagnant, unhealthy state as certain difficulties are almost sure to result. Sufficient ventilation is therefore also important. The best temperature for germinating the seed is around 80° F. Under no conditions should the temperature exceed 90° F. without adequate ventilation.



Aeration can be controlled conveniently with seed-beds of this type. Canvas covers are used during cold nights.

The grower is inviting trouble from damping-off if he keeps the soil too moist with insufficient ventilation, especially if the plants are thick in the bed. High humidity favours the development of fungi which cause damping-off, and ample ventilation is effective when endeavouring to check the disease. Watering should not be left until night or late in the afternoon if the weather is cool, as this leaves the beds cold during the night and will check the growth of the tender seedlings. After the seedlings have leaves the size of a twenty-five-cent piece, the watering should be more thorough and less frequent. A slight wilting of the plants through lack of water at this stage of growth will not injure the plants to any extent and will result in less damping-off.

Moulds and mushrooms occasionally appear in tobacco plant-beds. In this case heavy ventilation is also effective. The Dominion Experimental Station, at Harrow, has found that where large patches of mould persisted a weak solu-

tion of formaldehyde (1 dessert spoon of formalin to 2½ gallons of water) also proved fairly effective. This control measure apparently had no detrimental effects on either the germinating seed or the subsequent growth of the young seedlings.

E. Hardening-Off

It is usually a problem to get tobacco plants started in the field under dry weather conditions. Some fields are more protected than others and require less replanting, and in many cases even sheltered fields have to be planted over two and three times before a good stand is obtained. Plants which are not properly hardened-off in the beds before transplanting are usually more difficult to get started in the field than tough plants.

Hardening-off the plants should begin at least three to five days before transplanting. This is done by reducing the amount of water applied and by increasing the ventilation. Just enough water should be given to keep the plants from burning. An occasional good wilting will do no harm, but will help to toughen the seedlings. A simple test to know whether plants are tough is to bend the stem over the index finger. If it will bend, without snapping off, the plants are usually ready to set out. On the other hand, if the stem breaks easily the plants are too tender and should be left for a day or so to harden. The beds should receive all the ventilation possible, even by removing the covers or sash at night or by leaving the doors of the glass houses open. This will depend, however, on the outside temperature and weather conditions in general.

Another important point in securing strong plants is to withhold any forcing agents within ten days of transplanting. For instance, if nitrate of soda is applied during the time the plants are large enough to pull it will tend to keep the plants tender and watery. In hardening-off tobacco plants it is not advisable to go to extremes. Very woody, long, tap-rooted plants are not desirable for rapid subsequent growth in the field.

With adequate care and attention the seedlings are ready to set out in the field after four or six weeks growth in the beds. By this time they should have attained a height of approximately six inches.

CULTURAL OPERATIONS

A. Preparation of the Land

Consistent with weather conditions, land on which tobacco is to be grown should be ploughed early the preceding fall, in order to provide aeration and allow of the conservation of moisture. If farm-yard manure is to be applied to the soil, it should be spread prior to the last ploughing. Manure ploughed in during the fall will have time to decompose before spring, and the elements contained in it will be changed into soluble form available for use by the transplanted seedlings.

Spring work on the tobacco land should be done as early as possible, and, if manure has been applied the previous autumn, the field should be disked so as to mix the manure well into the soil. Spring manuring should be done early by spreading evenly over the field and either ploughing or disking in later. Commercial fertilizers are applied in the spring. Under present cultural conditions heavy applications are best applied broadcast over the field, preferably by machinery. With lighter applications not exceeding 1,000 pounds per acre, as for flue-cured tobacco, the fertilizer may be drilled in the rows about a week before transplanting. To avoid damaging the plant through burning, the fertilizer should be worked well into the soil immediately after its application. When applied broadcast over the field, the fertilizers can be disked or harrowed into the soil. Fertilization should be completed at least one week before transplanting commences.

B. Transplanting

Transplanting should be done during a period of cloudy weather as evaporation is less active under such conditions. The plants wilt less and recover more quickly. During the day the most favourable time has been found to be the cool hours of the morning or early evening.

In pulling the plants from the seed-beds the greatest possible care should be exercised to avoid breaking the roots. It is necessary, therefore, to water the beds well half an hour or so before taking up the plants. Care, also, should be taken to select only well-formed plants. These should be as uniform as possible, green and thick-set, with well-developed roots in order to obtain regularity of growth and size in the field. At no time should the roots be allowed to dry out before setting.

In transplanting it is always advisable to have some one follow the machine to uncover buried seedlings and reset missing ones.

On large plantations, horse-drawn planting machines are used. With the assistance of a driver they are operated by two men who do the transplanting. Such a machine sets out some twenty thousand plants a day and does the watering at the same time. If several acres of tobacco are grown this method of planting is relatively simple and inexpensive.

Hand planting is tedious and costly and is only recommended when the acreage to be planted is small. For this method the field should be marked both ways with a marker and the plants are placed at the points where the lines intersect. Small pegs are frequently used to make the holes into which

the plants are set, though, in very light soils the hand alone is used. Care must be taken to avoid setting the plants against undecomposed manure, or, covering the growing point of the seedling with soil. Bent roots, or air pockets around the roots, should be avoided also, as such practices delay development.

The distance between plants in the row varies according to variety, and, to some extent, according to soil type. The tendency of fertile soils to produce heavy-bodied tobacco can be rectified somewhat by setting the plants close together in the row, 20 inches in rows 38 inches apart for flue-cured varieties and 18 and 38 inches for cigar varieties. On lighter soils, flue-cured varieties do well when spaced 22 to 26 inches in rows 38 to 42 inches apart. Small-growing types such as Canelle and Petit Havane can safely be planted spaced at 12 inches in rows 30 inches apart. Havana types should be set 18 inches by 38 inches apart. Burley varieties, possessing in most cases very large leaves, must necessarily be set farther apart than either flue-cured or cigar types. For both yield and quality Burley types should not be set less than 28 inches in the row. Rows should be 42 to 44 inches apart. In all cases sufficient space is available between the rows for the use of horse cultivators until such time as the plants become too large to allow of cultivation without risk of damage to roots and leaves.

C. Resetting

Within a few days after transplanting, the field should be carefully examined for missing, broken, diseased, dead or insect-damaged plants. In all such cases replacements should be made with fresh healthy seedlings. To do this a small hole is made with a hoe, and if the weather is warm and dry, a cup of water is added, after which the plant is set out, taking care to pack the soil well about the roots. Dibbles or pieces of cone-shaped wood may be used to make the hole, but great care should be taken to ensure that the hole made is not too deep through the use of too long and sharp a dibble. Any air-pockets, as a result of not pressing the soil well up to the roots, will cause the roots to dry out before they can establish themselves in the soil. Resetting should be done early in order to obtain as uniform a stand of plants as possible. The value of this is clearly shown at harvesting when a uniform stand of plants can be expected to mature and ripen all at about the same time.

D. Time of Transplanting

There are many points in favour of early planting. The possibility of early fall frosts and also the difficulty of obtaining a thorough curing before the severe weather commences must be kept in mind. No definite dates for transplanting can be given, due to different weather conditions which prevail from year to year. Generally the best planting times are (*a*) for flue-cured, towards the end of May and early June, (*b*) for cigar leaf and pipe tobacco, the first part of June, and (*c*) for Burley, late May and early June. The general rule is to plant as soon as danger from frost is past.

If there is sufficient moisture in the soil early planting when the weather is still cool enables the young plants to readily establish themselves. They soon develop an abundance of new roots and are thus better prepared to withstand the dry weather of late June and July. Observations over a period of years have shown that early planted tobacco is usually superior in quality to that planted comparatively late.

E. Cultivation

The object of cultivation is not only that of destroying weeds, but also that of keeping the soil loose and friable. It facilitates aeration and assists in the conservation of soil moisture.

Early cultivations are very important in the production of a good crop of tobacco, but so often the benefits derived are not fully appreciated. They, however, afford several distinct advantages and are deserving of more attention. In the first place, cultivation should begin within at least a week of setting out the plants, even before they have become well established. As a result the crop makes a better start because cultivation brings more air in contact with the soil particles. It not only warms but also stimulates activity in the soil, which makes the fertilizer more quickly available to the plant. In addition a mulch is provided which prevents the surface soil from drying out too rapidly. Another distinct advantage is in the control of weeds which sap the soil of plant food and moisture. Cultivation is profitable even when rains are lacking and should be done at regular intervals of six or eight days. In any case, a cultivation should be given as soon as the soil is friable, following each rain.

This type of cultivator should be used two to three days after transplanting.

Hand-hoeing of tobacco is quite expensive and can be materially reduced by timely and thorough cultivating. Just what kind of cultivation should be given and the implement to be used will depend on the stage of growth and the number of weeds. A hoeing attachment placed on a two-horse cultivator is a very effective implement in the early stages of plant growth and reduces hand-hoeing to a minimum.

The depth of cultivation will vary somewhat with the season and with the condition of the soil. In general, it should be shallow and the ground should be kept relatively level. While early cultivation may be deep, it should not be too close to the row, as there is danger of disturbing the young plants. Subsequent cultivations should be more shallow as the plants develop, because deep cultivation will cause damage by cutting off many of the small roots. These small hair-like roots secure most of the food and water for the growing plant.

Care should be taken to avoid injury to the plants when cultivating. Such injury may spread any tobacco disease present and reduce both yield and quality of the crop. Cultivation should be completed before the tobacco is topped or at such time as the leaves spread sufficiently between the rows to obstruct the free passage of the cultivator, since the root growth on the tobacco plant usually extends beyond the spread of leaves.

F. Topping and Suckering

Topping and suckering are two cultural treatments in tobacco growing which are designed to hasten the ripening period and to improve the quality of the leaf. "Topping" refers to the breaking-off of the top or flowering part of the plant together with a number of the small young leaves. "Suckering" infers the removal of the small shoots or outgrowths which develop where the leaf stalk joins the main stem. Since the suckers are capable of flowering, they develop rapidly following topping. This phenomenon is merely a manifestation of the natural tendency of plants to reproduce themselves.

As there is no hard and fast rule for topping tobacco it remains with the individual grower to know his own crop and the conditions under which it is being grown. Factors such as soil texture, soil fertility, date planted in the field, distance of planting, type and variety and method of harvesting all have an important bearing on the practice that should be followed. Generally, the lighter sandy soils are found to be less productive than the more fertile loams. Tobacco grown on the heavier soils usually requires fairly high topping, while on the other hand lower topping may be practised advantageously on the less

Later on during the season a riding cultivator could be used. As the roots develop, cultivation should be shallow.

fertile soils. Tobacco planted early naturally has a longer season to mature than tobacco planted late. Higher topping, therefore should be practised on the earlier plantings. Close planting usually requires slightly lower topping than the wider distances of planting. This depends, however, on the fertility of the soil and the amount of rainfall at topping time. In general, tobacco should be topped to carry the maximum number of leaves that will properly mature.

There is no occasion to remove the suckers before topping but, under favourable conditions, they will grow rapidly. Upon reaching a length of about four inches they should be broken off. To leave them longer results in a waste of food which should be absorbed by the maturing leaves. They also become

woody as they age, making it increasingly difficult to break them off without damaging the plant. Two or three suckerings are usually made and care should be taken to see that all suckers, down to the ground level, are removed before harvesting. The priming method of harvesting flue-cured tobacco probably demands less attention to detail, in this matter, than does the stalk-cut method. In both cases, however, suckering should be done carefully and completely, if a good quality product is desired.

These treatments result in several distinct advantages. The plants are forced into a vegetative rather than a reproductive type of development. Certain products deleterious to good quality are removed. Nicotine content and leaf body is increased. Maturity is hastened, yields are increased and general quality is improved.

(1) Flue-cured Tobacco

Experiments conducted over a period of several years indicate a fairly definite relationship between height of topping and quality and yield of the cured leaf. It was shown that flue-cured tobacco topped low or around 12 leaves matured early and gave a fairly good yield, but the leaf was too dark in colour and too thick for a good quality of cigarette tobacco. On the other hand, tobacco topped high, at 18 or more leaves, produced a bright-coloured, thin leaf, papery in texture. An intermediate stage of topping leaving 15 to 16 leaves, gave more body and a satisfactory colour. In this case, topping was done in the late bud or early bloom stage. Although results varied to some extent with the different seasons, under average conditions, extremes in topping were not usually found desirable unless in special cases where the land was very fertile or very poor. New varieties such as Bonanza and Yellow Mammoth introduced with the priming method of harvesting, are practically all rapid growing and early maturing. The habit of growth of these varieties requires them to be topped 2 to 4 leaves higher than the old stalk-cut varieties like Warne and Gold Leaf.

(2) Burley Tobacco

During a normal growing season Burley tobacco is usually ready to be topped about eight or nine weeks after transplanting. Good results have been obtained when topped to 14 or 16 leaves in the late bud stage. Small plants, on the other hand are usually topped low, leaving only 10 or 12 leaves. Low topping on normal plants produces a coarse rough leaf, while high topping produces small immature leaves. Some of the Standup varieties such as Standup Resistant produce 3 to 4 more leaves than others such as Judy's Pride and Halley's Special and consequently should be topped accordingly. In conclusion, it may be emphasized that early topping usually means sufficiently low topping and early maturity.

(3) Dark Tobacco

In the past it has been found advantageous in the culture of dark tobacco to "prime" or remove from the plant the bottom leaves either at time of topping or during the first and last suckerings. During a very dry season the lower middle leaves may receive more protection by no priming, while in a very wet season the bottom leaves sometimes protect the middle leaves from splashings with mud. Whether primed or left on the plant until harvesting, the bottom 3 to 5 leaves are of little or no value and might just as well be removed from the plant before going into the curing barn. In a normal year dark tobacco should be topped in the early bud stage, suckered twice or more and "primed" to the extent of the five bottom leaves at topping time or two weeks later. If priming is left until the time of harvesting, both the yield and wrapper qualities of the leaf are impaired.

(4) Cigar Tobacco

Cigar tobacco, in common with the other types, should be topped as early as possible. The height at which to top is a matter which must be decided by the grower. In a normal year it is usually safe to leave about 14 to 16 leaves on the stalk depending on the variety. Experiments carried on over a number of years indicate that the optimum topping and suckering treatments for cigar binder tobacco are as follows: Medium topping in the early bloom stage of growth with two or more suckerings, the first a few days after topping and the last just prior to harvesting. On no account should suckers be allowed to remain on plants entering the curing barn.

(5) Pipe Tobacco

In general the topping and suckering practices as recommended for cigar tobacco are much similar to those necessary for pipe tobaccos. No more leaves should be left on the plant than will mature properly and cure without adversely affecting the quality of the crop.

HARVESTING

A. Maturity

Tobacco should be harvested as soon as it is ripe. Quality is sacrificed when tobacco is not allowed to reach the proper stage of maturity. Immature tobacco does not cure satisfactorily. Good colour and texture are dependent largely on maturity. On the contrary, over-ripeness is equally deleterious to quality. Consequently, the importance of good judgment in gauging the maturity of tobacco cannot be over emphasized.

When tobacco approaches maturity certain distinct symptoms appear in the leaf. The colour of the leaf changes from a uniform green to a yellow mottled green. The leaf also becomes more granular in texture. The bottom leaves invariably ripen first. Fading out of the green colour is noticeable in the lower leaves while mottling is more pronounced in the upper portion of the plant. Since the margin of the leaf near the tip ripens first, the development of hardened or granular tissues causes a slight inward curving of the leaf margin, giving the leaf a constricted appearance. When over-ripe the leaf becomes pebbly and slightly corrugated. Some types of tobacco when ripe exhale a characteristic odour especially during hot weather.

An old fashioned test for maturity can be made by creasing the leaf; a characteristic snap indicates maturity. This test is, however, more applicable to the heavier tobaccos.

Symptoms of maturity differ somewhat with the various types and familiarity with the type in question is important in judging maturity.

When the stalk-cut method is used, harvesting should be done when the top leaves are ripe enough to take a good colour in curing, and before the bottom leaves are over-ripe. Under normal ripening conditions harvesting should begin before the bottom leaves become bleached, yellow in appearance, because a loss occurs in their weight, elasticity, and soundness if left too long.

In some cases the plants may ripen irregularly. An extended drought, for instance interferes with normal development and causes premature yellowing. This starved or "sun yellow" condition, as in flue-cured tobacco, accompanied by drying up or "firing" in the field is often confused with ripening. Sometimes it may be necessary to harvest the tobacco in this stage to prevent severe loss of the leaves, but a crop of this kind is usually poor in quality and light in weight. Rain often improves a crop in this condition.

95616—3½

Tobacco should not be harvested too soon after a rain, since rain washes from the leaves soluble gums, oils and resins, which facilitate curing. Hence, if the leaves resume a green appearance the tobacco should be left until signs of maturity reappear.

B. Methods

(1) Flue-cured Tobacco

The priming method of harvesting flue-cured tobacco, introduced in 1930, has replaced the split-stalk method almost entirely in Canada. It consists of picking the leaves as they ripen rather than cutting down and curing the whole plant. When the bottom leaves are showing evidence of maturity priming should begin. "Primers" or pickers walk along the rows removing the ripe leaves and placing them on narrow "sleds." On these they are hauled to the kiln where they are strung on laths. The leaves are strung in bunches of three with twelve to fifteen bunches on each side of the lath. The stringing is done with cord and the bunches secured by placing half-hitches around their butt-ends. The cord is tied to each end of the laths which are then hung in the kilns.

When the bottom two to four leaves have been removed at the first priming the remaining leaves may ripen to better advantage. The second priming in which the lower middle leaves are removed usually follows about a week or ten days after the first priming. Three to five primings are generally made in harvesting the leaves. Low quality leaf and tips should be left in the fields.

The split-stalk method of harvesting flue-cured tobacco was used almost universally in Canada prior to the introduction of priming.

As in the case of priming, when the stalk-cut method of handling tobacco is employed, harvesting should only take place when the tobacco has ripened satisfactorily and when the weather shows indications of permitting the harvesting of sufficient tobacco to fill a kiln. Cutting should not begin until the dew has dried off. Special knives are used for cutting flue-cured tobacco. The stalks are split to within a few inches of the ground and then cut off. Different systems may be followed in handling flue-cured tobacco by the split-stalk method. If the plants ripen uniformly they may be cut and allowed to wilt slightly and then immediately straddled on the laths and hauled to the kiln. Another method which is more satisfactory, especially when the crop lacks uniformity is the crew method. Harvesting is done in this case by crews of two or three. One man holds the lath while the other two cut the ripest plants and straddle them over the lath. The latter method involves less handling of the plants. Laths will accommodate from six to eight plants depending on the size of the plants. Special horse-drawn tobacco racks are used to transport the tobacco from the field to the kiln.

Obviously, the labour required to harvest a crop of flue-cured tobacco by the stalk-cut method is less than that required to prime the crop. The slightly higher cost incurred by priming is more than offset by the improvement in quality and increased yield. Priming affords a greater opportunity to pick only those leaves that are uniform in thickness and maturity. For this reason such a crop is cured more easily. A greater acreage can be accommodated per kiln, and the time and fuel required for curing are reduced considerably. Furthermore, it has been shown by experimentation that translocation of substances into the stalk removes from the leaf certain materials which otherwise tend to improve the quality in primed tobacco.

Additional advantages of priming include less frost hazard, since the choice portion of the crop is saved before the frost season begins. There is a more even distribution of labour, owing to the greater continuity of harvesting operations. Grading is also simplified since leaves from each region of the plant are together in the bulk.

(2) Burley and Dark Tobacco

At the present time practically all Burley and dark-fired tobacco commercially grown in Canada is harvested by either the split-stalk or spearing method which is described in detail in the discussion of harvesting methods for flue-cured, cigar and pipe tobaccos.

(3) Cigar and Pipe Tobacco

In the province of Quebec where most of the cigar and pipe tobacco produced in Canada is grown, the crop is stalk-cut, wilted and speared on laths. Conditions as to ripening, etc., are the same as for the split-stalk method. The method of placing on the laths, however, is different.

Long handled shears are used in stalk-cutting tobacco. The plants are removed at the ground level.

When ripe, and on a bright dry day, the plants are cut down at the ground level either by means of a hatchet, or, more commonly, with long-handled shears made for the purpose. With butts facing the sun, the plants are allowed to lie on the ground and wilt in the sun until they can be handled without fear of damaging the leaves. After wilting, the plants are speared about five inches from the butt end, on to laths by means of a V-shaped metal spear which fits over the end of the lath. Care should be taken to spear through the middle of the stalk and also far enough away from the butt to prevent splitting the stalk to the end and allowing the plant to slip from the lath. In order to facilitate the operation of spearing, one end of the lath is placed in a wooden "horse" or rack, which holds it horizontally and allows the requisite amount of pressure to be applied when the stalk is drawn over the spear-head. The spears, which are removable, should be kept sharp.

Having wilted in the field for an hour or so the plants are carefully speared on laths.

Cigar leaf must be carefully handled to avoid bruising or other such injury to the leaf.

From six to eight plants, depending on their size, may be placed on one lath and are drawn to the curing barn in special racks which are so constructed as to cause the minimum amount of damage during transit.

With a suitable wagon one man can load tobacco on the lath in the field.

SEED PRODUCTION

That the tobacco plant is one of the most susceptible of all plants to changes in soil and climatic conditions has been conclusively proven by experiments and in actual field practice. Varieties which were practically ideal for the production of a certain type of leaf in one section of the country, upon being taken to another section where the soil and climatic conditions are different, became so changed in their quality characteristics as to be practically worthless for commercial production. Thus the advantages of well produced locally-grown seed, are readily seen and the importance of obtaining acclimatized seed for the production of a high quality, early maturing crop can not be over emphasized.

The production of high-class tobacco seed involves much time and labour as well as careful judgment as to types to select for production purposes. Registered tobacco seed can now be secured in some of the main tobacco-producing areas of Canada, and purchase of this seed is strongly recommended. Samples of seed produced by registered growers are examined by the Canadian Seed Growers' Association, the Seed Branch of the Dominion Government as well as certain Branch Farms of the Dominion Experimental Farms System, under whose supervision the seed is produced. Protected by these government agencies, the purchaser of registered tobacco seed can be assured that he is buying a first-class product.

For the benefit of those who do not find it convenient to purchase registered seed, the following information on home seed production is presented.

The selected seed plants should be as nearly representative of their type as possible. The grower must select with a fixed idea as to the type of plant most desirable for his market. He should take into consideration the general character of growth, the number, shape, size and uniformity of leaves, the length of internodes, the time and uniformity of ripening, the number of suckers

produced and the colour of the leaf. The whole field should be gone over before topping, then at least twice more for the elimination of the less desirable types included in a previous selection. Selected plants should be marked so as to ensure that they will not be topped but reserved for seed.

Tobacco is naturally a self-fertilized plant. Bees and other insects flying from flower to flower will carry the pollen, however, from one plant to another; and if off-type plants should bloom near the selected ones there is a chance of cross-fertilization unless the flower cluster is protected. Just before the first flowers open, each of the flower clusters on selected plants should be trimmed up until only the three top branches remain. This ensures the production of early viable firm seed.

After trimming, the seedhead is covered with a fourteen-pound manila paper bag, the mouth of which is tied or wired loosely around the stalk 4 to 6 inches below the lowest cluster of the seed head. Owing to better diffusion of light, white bags are preferred to darkly coloured ones. About every ten days the bags may be removed and all suckers and fallen blossoms taken out. Breaking the leaves off the plant during the bagged stage would hasten ripening but approximately ten leaves should be left at the time of bagging. Additional leaves may be removed gradually as the season advances.

As soon as the seed pods start to turn brown, the bag may be removed to permit ripening in the open sunlight. All flowers present at this time should be discarded. After the greater portion of the pods turn brown, and before frost, the seedhead should be broken off carefully and allowed to hang in a clean dry ventilated shed or room for about two months. Frequently, artificial heat, not over 100° F., is applied to hasten drying out.

After the pods have become thoroughly dry and brittle the seed is ready for threshing. This is accomplished by first crushing the pods. The chaff is removed from the seed by careful sifting after which it must be thoroughly cleaned. Twenty-five or thirty seedheads, trimmed as described above, are usually required to produce one pound of plump clean seed.

The cleaning process consists of the removal of dust and light seed. As few farmers are equipped for this operation growers are advised to have this work done for them at the nearest Dominion Experimental Station where they will be assured of receiving clean seed of high germination.

CURING

A. Flue-cured Tobacco

Curing is extremely important in the production of bright flue-cured tobacco. A well-grown crop can easily be ruined through improper curing. Moreover, it is folly to expect that curing can make amends for quality which is lacking as the result of unfavourable growing conditions.

Flue-curing is done in a kiln which is usually built on a four-foot concrete foundation. The inside of the kiln is equipped with four to six "rooms" or rows of hangers. Provision is made for hanging from five to seven tiers, thus providing accommodation for eight hundred to eleven hundred lath per kiln. The walls are air-tight and provision is made for top and bottom ventilation. Doors at either end facilitate hanging and taking down the tobacco with a minimum of time and labour. Heat is supplied by wood or coal-burning furnaces. Natural gas is also used in some cases where it is available. The heat is evenly distributed by means of pipes or flues arranged in the bottom of the kiln. The temperature and humidity relations, which should be maintained during curing, are influenced by a number of variable factors. Among the most important of these are weather conditions, relative ripeness, uniformity and

thickness of leaf. Obviously, no specific rule or formula can be given and knowledge of curing gained through practical experience is, therefore, considered essential for good results. In the first place an attempt should be made to select leaves of uniform ripeness and thickness. Tobacco should not be over-ripe or over-wilted. Over-crowding in the kiln should be avoided and ample space allowed for heat and air circulation especially during hot weather. Proper ventilation is very important in maintaining the necessary temperature and humidity relations. A reliable thermometer and hygrometer, located near the centre of the kiln on a level with the bottom tier of leaves, serves as a dependable guide in curing.

Properly constructed kilns make the curing of cigarette tobacco relatively easy.

The curing process of primed flue-cured tobacco consists of three main stages: yellowing the leaf, fixing the colour, and drying the leaf and stems. The entire process requires from 68 to 96 hours for completion. The yellowing period requires from 30 to 40 hours with a temperature range from 80 to 110° F. All doors and ventilators should be closed when the tobacco is starting to yellow because ventilation at this stage will delay the yellowing process. During the first 12 to 18 hours of curing the temperature should range from 80 to 95°, depending on the outside temperature. The difference between the temperature in the kiln and the outside temperature, at the start of the cure, should not be more than 10 or 15°. Too great a difference indicates a low relative humidity which has a tendency to cause the leaf to dry green. If a high relative humidity is apparent, when the yellowing has started nicely, the temperature should be raised to 100 or 105° F. allowing a little top and bottom ventilation. During the first 30 or 40 hours the ventilation should be increased, as yellowing progresses, to maintain a lemon-yellow colour. The temperature in the kiln may range as high as 25° above the outside temperature during the final stages of yellowing. As soon as most of the leaves have become evenly yellowed the top and bottom ventilation should be increased and the temperature raised to 110 or 112°. This temperature must be maintained from 4 to 6 hours or until the leaves have only a tinge of green left. At the end of this period the tobacco has reached the stage for fixing the colour.

Fixing the colour requires from 12 to 20 hours with a temperature ranging from 110 to 140°. As the temperature is increased beyond 110, the difference between the readings on the hygrometer should be from 20 to 25°. This may be attained by increasing the top and bottom ventilation, and by gradually raising

the temperature in the kiln. If the moisture has not been reduced sufficiently within 3 or 4 hours the temperature should be raised to 120 degrees. Again, if further difficulty is experienced in reducing the moisture sufficiently, the temperature in the kiln may be "flashed," that is, raised quickly from 112 to 120°, and after about half an hour allowed to drop back to 110. One or two such flashes are usually sufficient to drive out the excessive moisture. Flashing is done to prevent the sponging or scalding of the leaf owing to the presence of too much moisture. Now, the temperature again should be raised quickly to 120 and the changes in the tobacco on the bottom tier should be observed carefully. The warmest and coolest places in the kiln should be noted and the temperature regulated according to where the tobacco is curing satisfactorily. If the tobacco is drying nicely the temperature must be maintained at 120° for 5 to 8 hours. If not, another quick flashing up to 130° is required and then allowed to drop back to 124°. When the leaves on the bottom tier have curled nicely and those on the second tier have started to curl the temperature should be raised to 130 or 134° and retained at this point for 4 to 6 hours. The temperature should be increased to 140 or 145° and maintained at that point until the leaves and a portion of the stem are cured completely.

The remainder of the process consists of drying the leaf and stem. This requires from 12 to 24 hours with a temperature ranging from 140 to 180°. The top and bottom ventilation may be reduced at this stage, allowing slightly more ventilation at the top than at the bottom.

When the stems are thoroughly dried the tobacco is ready to cool and bring in case for handling. This is accomplished by opening the doors and ventilators when there is moisture in the outside air. While the natural moisture condition of the air is preferable for bringing tobacco in case, steaming is fairly satisfactory. This method is often employed when it is necessary to empty the kiln immediately.

B. Cigar, Burley and Pipe Tobaccos

Cigar, Burley and pipe tobaccos are air-cured and ordinarily it is not necessary to furnish artificial heat. Contrary to flue-curing, air-curing is a long time process and normally requires two to three months for completion.

The air-curing barn should be located on a site with adequate soil and air drainage. Low areas situated near marshes should be avoided as well as high places exposed to strong winds. Air-curing barns may vary in size, but are more satisfactory if not too large; ordinarily a better cure is obtained in a smaller-sized barn since filling can be completed within a shorter period. To facilitate uniform ventilation the barn should be built lengthwise to the direction of the prevailing wind. Plenty of ventilation is important. Ventilators should be provided on all sides of the barn, in the gables and on the ridge. In construction the barn is equipped with hangers for holding the laths of tobacco. The tiers of these hangers must be spaced far enough apart to prevent the tips of the plants above from interfering with the butts of those below and also to permit adequate air-circulation. The bottom tiers should be placed high enough above the ground to allow a clearance of at least two feet between the tips of the tobacco and the floor.

Certain facts are worthy of consideration when filling an air-curing barn. It is not advisable to hang freshly harvested tobacco below that which is partly cured, since the moisture rising from the green tobacco may have an injurious effect on the partly cured leaf. This applies especially to the lower middle section of the barn where the danger from pole burn is usually greater. Curing progresses more rapidly in the top of the barn and it is advisable for this reason to arrange the tobacco so that the later harvestings can take advantage of the more rapid curing.

To permit adequate circulation the laths should be placed six or nine inches apart on the hangers. In general, the objective in curing tobacco is to dry the leaf in such a way as to preserve the qualities and also to bring about the desired colour in the leaf. The first change that takes place is apparently natural, since yellowing begins almost immediately after the leaf is thoroughly wilted. The leaf continues to change in colour until it becomes a light brown. The control of the relative humidity is extremely important at this stage to maintain this brown colour while the stem is being dried out.

Adequate facilities for ventilation and driveways are essential features of an air-curing barn.

If the barn is filled within one or two days' time it is usually a good practice to close the doors and ventilators for the first two or three days or until the leaf starts to yellow. The ventilation given at this time depends greatly, however, on the size of the tobacco and on the prevailing temperature and humidity of the atmosphere. If the weather is warm and humid, top ventilation should be given from the beginning. During this time the temperature should be 70 to 100° F. with a relative humidity of 85 to 90 per cent.

After this period the barn should be thoroughly ventilated. The ventilators should be closed at night during cool, foggy or rainy weather, and opened during the day so that excessive moisture may escape. When the weather is very dry the doors and ventilators should be closed during the day-time and opened at night in order to retain moisture and thus prevent the tobacco from "haying out" or drying too rapidly. On windy days the ventilators on the windward side should be closed in order to prevent drying and whipping of the leaves.

Other hints and points to remember may be tabulated as follows:—

1. As soon as the edge of the leaf has turned brown and when the midrib has become limp, all the ventilation possible should be given. If the weather continues dry, the side ventilators may be closed during the day and opened during the night.

2. Excess sweating during the browning stage should be avoided.

3. The remotest points from the ventilators should be observed frequently, since mould and pole-burn are most likely to occur in the centre of the barn.

4. If the weather continues cold and damp and the tobacco is not curing well, the temperature should be raised to about 90° by means of charcoal burners, oil burners, or open charcoal fires to reduce the relative humidity to 85 or 75 per cent until conditions improve.

This type of charcoal burner is of considerable value during a wet season when air-curing is difficult.

5. When the leaf is well cured and the midrib dried out, the doors and ventilators should be closed until such time as conditions are favourable to bring the tobacco in case.

C. Dark-fired Tobacco

Dark tobacco may be either air-cured or fire-cured depending on its use. If air-cured it is handled similarly to Burley or cigar tobaccos. In case of fire-curing dark tobacco, special barns are constructed on a three-foot concrete foundation. These barns are equipped with tight, easily operated, vertical ventilators on the two sides, in the gable ends, and on the ridge. In addition to large doors at each end of the double driveway, a small door on each side is found convenient for attending the fires.

The hangers are arranged at intervals of 3 feet 10 inches horizontally and 3 feet 6 inches vertically and the laths of tobacco, when hung, are lapped or slightly "shingled." The bottom set of hangers is 9 feet from the ground. Although large barns are used for curing this type of tobacco, the smaller barn with a 4 to 6 acre capacity is more conveniently controlled.

The method used for fire-curing dark tobacco is more or less a combination of the air-curing and flue-curing process, although historically it is perhaps the oldest of all methods of curing tobacco.

The principle of fire-curing tobacco may be compared to that employed in smoking hams and bacon. The smoke from smudge fires imparts a character-

istic odour and taste to the tobacco and improves its keeping qualities. Hickory, maple, oak and beech are among the woods desirable for smoking. Damp sawdust is used for smudging.

No standard method can be given for fire-curing tobacco. Equally good results have been obtained from a number of practices, which vary widely. It may be in order, however, to outline a method that has been used satisfactorily. Usually, no heat is given during the first stages of yellowing, because, if applied at this stage, the leaf may dry out too rapidly. From 3 to 5 days after harvesting, slow fires, about 12 feet apart, are started on the floor of the barn and the temperature is maintained at 90 to 95° F. until the yellowing of the leaf has been completed. The temperature may then be increased to 125 or 130° and held at that point until the leaf tissue is fairly well dried out. At this stage of the curing, when the tobacco is still full of sap, too much heat should not be applied, as portions of the leaf may become discoloured by "scalding." The fires are then allowed to go out and, when the tobacco has come in case, the fires are started again, and alternate drying and softening is continued until the stems of the tobacco are completely dried. This process usually extends over a period of 10 to 18 days.

Since economy of fuel has become an essential factor in curing dark tobacco in Western Ontario, the practices used in firing have been modified to some extent. Sometimes well-smudged fires, furnishing dense smoke with very little heat, are built as soon as the barn is filled. After 2 or 3 days the heat is increased and the firing continued until the stem is partly dried. After this time the fires are allowed to go out and the tobacco is subjected to air-curing for the remainder of the process.

As the fire-curing of dark tobacco is a difficult process, certain precautions should be taken. Yellowing at a high temperature tends to dry out the leaf too rapidly, resulting in green or slatey-coloured tobacco. In the attempt to obtain extremely dark colours sweating is necessary and any delay in removing this excess moisture, owing to firing at a low temperature, often results in much pole-burned tobacco. The fire hazard is usually high owing to the use of open fires. Some means of protection are advisable. The smouldering logs may be covered with sheet metal or old flue furnace pipes split open. An available supply of water should always be kept on hand.

D. Curing and Fermenting for Home Use

When the crop is properly matured in the field, the plants should be cut off at the base with a small hand axe and laid on the ground to wilt, preferably, with the butts toward the sun. Care must be taken at midday in hot weather not to allow the leaves to become sun-burned, since this causes permanent damage. When the plants have wilted sufficiently so that they can be handled readily without breaking the leaves off the stalk, they may be placed in piles and strung on laths, fitted to an iron spud, to facilitate spearing the plants onto the lath. From five to seven plants, depending upon the size of the tobacco, should be placed on each four-foot lath.

As soon as the tobacco plants are strung they may be carried into a barn or other sheltered situation and hung tips downward to cure. A space, from five to eight inches, should be left between the laths of hanging tobacco, in order to allow proper ventilation.

When the leaves and midribs are entirely dried, the tobacco may be taken down and placed in a pile at some time during a period of rainy weather, which has rendered the cured leaves sufficiently pliable to handle without breaking. The leaves may then be stripped from the plants and packed tightly into a bale or a box.

In order to be fit for consumption most tobaccos require a certain period of fermenting and aging. It is difficult to properly ferment small quantities of tobacco, since the heat developed is not maintained long enough to effect the necessary changes. However, if these small amounts of tobacco cannot be kept sufficiently and constantly warm for a period of several weeks without drying out, it is not possible to develop considerable flavour and aroma. To have this, the leaf must be packed in a nearly air tight box and kept in a warm place at least at about 100° F. where the heat is fairly constant for several weeks. Following this, if the tobacco is allowed to " age " for a period of from six months to one year, its quality should be greatly improved.

PREPARATION FOR MARKET

A. Flue-cured Tobacco

When this type of tobacco is cured at least a day is required before the kiln is completely cooled. The doors and ventilators are then opened to allow the tobacco to come into case. It is usually possible for the leaf to take up sufficient moisture during one night to permit its removal from the kiln or curing barn the following day. During very dry periods of weather moisture must be placed in the kiln to bring the tobacco into case by low-pressure steaming. Additional moisture can be obtained by wetting the floors and by placing damp bags over warm pipes but care must be taken to prevent excess free moisture from collecting on the cured leaf. Natural casing from outside atmospheric moisture always is preferred.

A good pack barn is required for stripping, grading, baling and storing the crop.

When the tobacco is removed from the kiln it is piled or " bulked " on the lath, until such time as it can be graded and baled. Under favourable conditions, flue-cured tobacco improves in the bulk. This depends, however, on the prevailing temperature and humidity of the atmosphere and the amount of case in the tobacco while in the bulk. Tobacco stored in too high case has been known to discolour, mould or even rot in the bulk. Under certain conditions it may be advisable to rebulk the tobacco two or four weeks after the first bulking, since turning the leaf contributes to further improvement of the colour.

Frequently steam is used for stripping and baling to bring it into sufficient case for handling. Ordinarily this is accomplished by turning on low-pressure steam into a special steaming room where the tobacco is hung for casing. If the priming method of harvesting is used, the leaves are simply removed from the string on the lath. The crop at this time is baled into two or three grades depending on the particular requirements of the purchaser.

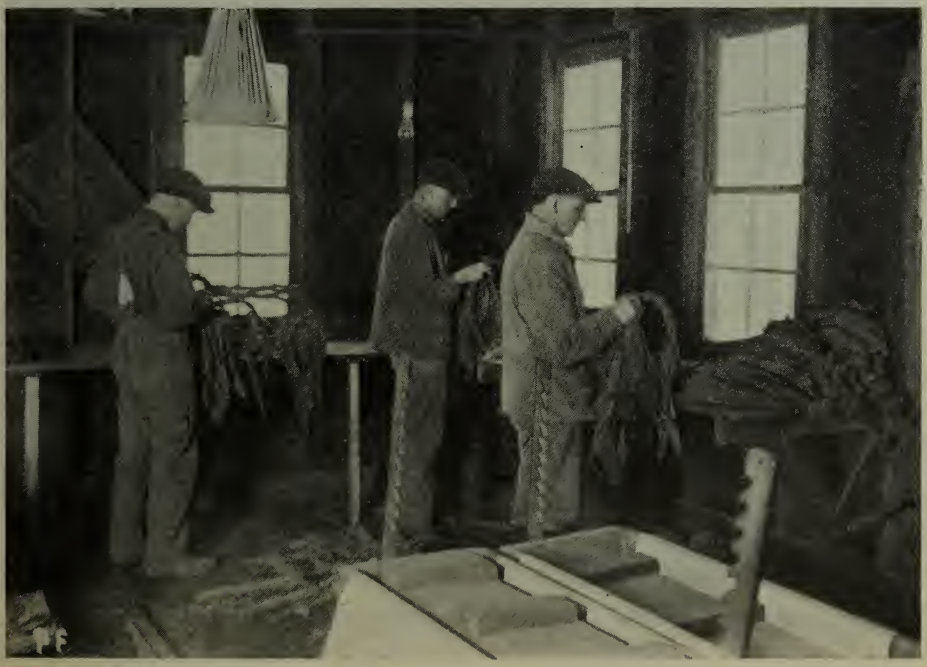
B. Burley, Dark, Cigar and Pipe Tobacco

Tobacco of these types are allowed to come into case while hanging in the curing barn by natural atmospheric moisture conditions during a period of dampness or high humidity.

During good casing weather Burley and dark tobaccos are taken down in the curing barn and the plants are removed from the lath and bulked in a dry place with just sufficient moisture for proper handling. If properly cased and bulked it may remain in this condition for ten days or more. Ordinarily, a grower bulks down only a portion of his crop at one time. The tobacco remains in case in this bulk and can be stripped and baled directly when time permits. Frequently tobacco contains high moisture and, in this case, it is advisable to bulk it on the lath. It is a good practice to examine the tobacco occasionally, as mould and change of colour is apt to occur in the bulk if the weather should become warm. The possibility of such danger would necessitate immediate rebulking.

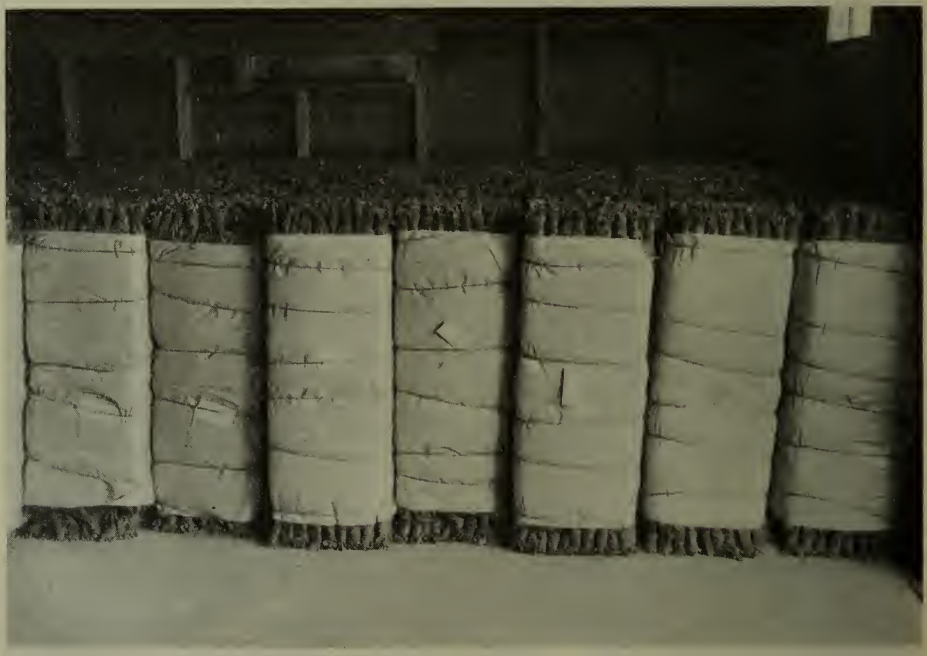
In order to preserve the bright colour of cigarette Burley it should be removed from the curing barn as soon as completely cured and bulked down as described above with just enough moisture to permit good handling. If cigarette Burley is bulked with a comparatively low moisture content the colour invariably will be preserved. Too much moisture not only darkens the leaf in the curing barn but also in the bulk and bale.

Similar practices are followed in handling cigar and pipe tobacco except that the tobacco is always bulked on the lath to await stripping.



With stalk-cut tobacco the leaves are removed from the stalk after curing.

After stripping the leaves are carefully pressed into bales.



The baled tobacco is now ready for shipment.

DISEASES AFFECTING TOBACCO

Like most crop plants tobacco is affected by a large number of diseases. Altogether, there are some thirty or forty which have been definitely reported in the various tobacco growing districts in different parts of the world. Some of these, such as mosaic and wildfire, are world-wide in their distribution. Blue mould and the slime disease, for instance, are only found in tropical or sub-tropical regions. Still others are more prevalent in the temperate zones and it is in this category that those most troublesome in Canada are found.

Seed-bed Diseases

Damping-off

(*Pythium, Fusarium* and *Rhizoctonia* Spp.)

The rotting or damping-off of the young seedlings in the seed-bed is caused by fungi which spread very rapidly in circular or irregular patches in which practically all of the plants in the infected area wilt down and rot. The plants attacked by this disease usually begin to rot near the surface of the ground, though the infection may spread up the stalk to the leaves which also decay. Infected plants generally die, giving evidence of the attack by a brownish dead area on the stalk near the root. Such plants should be discarded as they seldom prove satisfactory when transplanted. This disease is most prevalent in thickly seeded, moist, poorly ventilated beds.

Sterilization of the seed-bed and thin seeding are the most effective methods of prevention. The disease may be checked when it occurs by throwing out the infected plants, lowering the temperature, thereby giving adequate ventilation and allowing the bed to dry out for a short time.

Sunburn

Poor ventilation or hot sunny days also causes considerable loss. In addition, many growers burn their plants with nitrate of soda by neglecting to thoroughly wash off the leaves with water.

Miscellaneous

Seed-bed mould (*Pyronema confluens*) causes some trouble to a limited extent in Western Ontario. Fleshy fungi (*Coprinus* spp.) frequently appear where fresh manure or straw is used in the beds. These of course do not attack the plants, but on developing in large numbers they spoil the beds and cause considerable trouble.

Field Diseases

Black Root-rot

(*Thielavia basicola*)

This fungus attacks the entire root system although greatest damage is done to the young fibrous roots causing them to decay. These roots then cease to function as food carriers and, as a result, the plant is starved. The degree of starvation depends upon the extent to which the plants and field are infected, the climatic condition prevailing at the time of transplanting and the hardiness of the plant.

In the seed-bed, infected seedlings usually present a somewhat yellowish unthrifty appearance and frequently are slow in growing.

In the field the plants show the same unthrifty appearance and lack of growth. The whole field may appear patchy and, on examination of the roots, dark lesions are found. If healthy plants are placed in a disease-infested soil, climatic conditions may favour either the growth of the plant or the development of the disease.

Black root-rot organisms live in the soil and cause an uneven growth of the crop.

To eliminate the disease it is necessary to produce healthy plants and transplant them only to disease-free fields. The seed-bed should be thoroughly sterilized before seeding. No plants should be transplanted from a diseased bed as they may spread the disease over the entire field. If the fields become infested, a good rotation should be practised. Liming should be avoided and the use of acid fertilizers to offset the soil reaction also is recommended.

Mosaic

(*Virus*)

Mosaic is becoming one of the most serious diseases affecting Canadian tobacco. Its prevalence is general on the lighter soils and it is particularly serious in Southwestern Ontario.

Mottling of the leaves with alternate dark-green and yellowish patches over the leaf surface are characteristic symptoms. These irregularly scattered areas are more pronounced in the tip or youngest leaves. In more advanced stages the leaves become distorted, curl and blister. Growth is checked and the entire plant is dwarfed and bleached. After topping infected leaves frequently break down, rust or burn under certain weather conditions.

The disease is highly infectious and easily transmitted. Under somewhat arid conditions it lives through the winter in cured tobacco and other plant refuse.

So little is known relative to the cause of this disease that control measures are merely those of prevention. Seed-beds should not be placed where there is the slightest danger of infection. The plants should be handled only by those

A mottling of the leaf is a distinct characteristic of mosaic infection.

Mosaic infection of the centre row has retarded growth.

who have had no contact with plant refuse or cured tobacco suspected of infection. Diseased plants in the field should be pulled immediately and destroyed before infection spreads to healthy ones.

Wildfire

(Bacterium tabacum)

The most characteristic symptom of this disease is the occurrence of a definite light coloured halo around the spot of infection caused by a toxin from the bacteria. This symptom may be observed in all stages of development and it clearly distinguishes the disease from angular leaf spot. In the younger spots the shape is usually circular although coalescence may take place later.

Wildfire is quite common in Quebec and does considerable damage once established in or around the seed-beds.

Angular leaf spot is sometimes known as blackfire. It is not so common as wildfire. Note the angular outline of the spots.

To control the disease all field refuse and stubble should be ploughed under. Sanitary measures should be practised in and around the curing barn by removing all tobacco leaf trash. The seed-bed should be located some distance from the barn and all sashes and frames disinfected with formaldehyde. As there is very little that one can do with infection, once it becomes established, it is advisable to treat the seed before planting with silver nitrate, one part to a thousand, for two successive ten-minute periods.

Leaf drop, attributed to nutritional disturbances, frequently causes considerable damage to tobacco grown in the Okanagan Valley of British Columbia.

Angular Leaf Spot of Blackfire

(*Bacterium angulatum*)

This disease is sometimes confused with wildfire. Although more widespread it causes less injury. The spots are usually dark brown in colour with sharp irregular margins. There is no light coloured halo as in the case of wildfire. Although considerable variation occurs there is very little difficulty in recognizing this disease.

Measures similar to those recommended for the control of wildfire are effective in its prevention and eradication.

Miscellaneous

Frenching, sand-drown, leaf-drop, brown root-rot and potash starvation are attributed to nutritional disturbances and possess characteristic disease symptoms but they are not infectious. Other diseases such as hollow-stalk, sore-shin, Fusarium wilt and frog-eye (*Cercospora*) leaf spot occasionally occur but the extent of their injury to a crop is limited.

Curing Barn Diseases

Shed-burn

Shed-burn is frequently known as pole-rot, pole-burn and pole-sweat and in severe cases it completely destroys portions of the leaf tissue. As decay proceeds infected areas become lifeless and later, upon drying, fall out if disturbed. This trouble is very common in air-cured tobacco and is attributed to excessive humidity and poor ventilation which favours the development of certain micro-organisms.

Proper ventilation and raising the temperature by artificial heat, if necessary, thereby lowering the humidity, constitute the only measures of control.

INSECTS AFFECTING TOBACCO

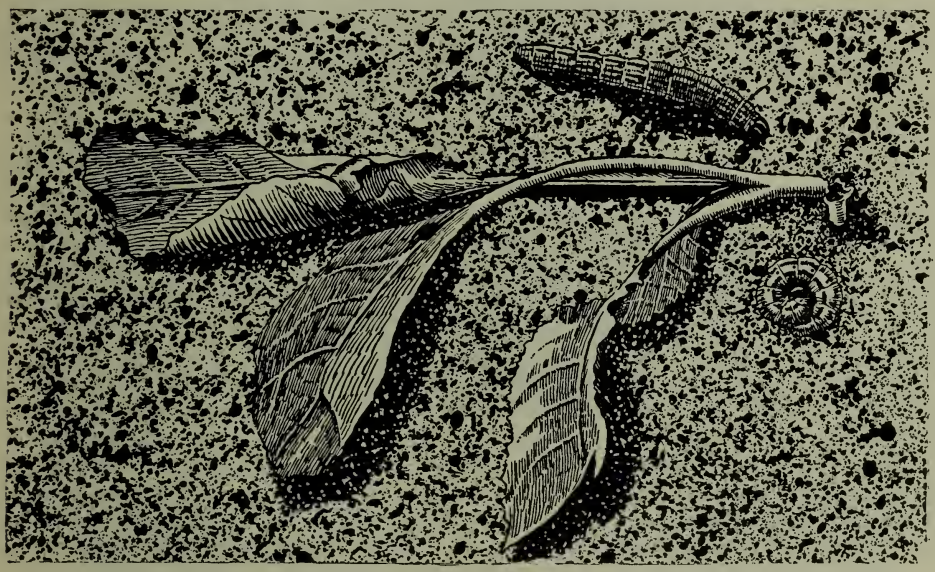
Prepared by Geo. M. Stirrett, B.S.A., M.Sc., Dominion Entomological Laboratory, Chatham, Ontario

With the rapid expansion of the tobacco growing industry, the control of insects which attack the plants has become, in recent years, an important problem. They are not, fortunately, of many types but are of sufficient importance to be dealt with promptly, intelligently and continuously. The more important ones include (1) cutworms, wireworms, and stalk borers also known as tobacco webworms, which live in the soil, and (2) tobacco worms, flea-beetles, and grasshoppers which live on the foliage. Cutworms cut the plant stem either below or above the ground. Certain kinds, however, climb the plants and eat the leaves. Wireworms riddle the main root-stalk and often burrow up or down within the stem. Stalk borers usually enter the stem just below the ground surface and burrow up or down the centre. The damage by each of these soil-infesting insects is noticed soon after the plants are set out. Of the leaf-eating insects, flea-beetles make numerous tiny circular or angular holes in the leaves and do most of their damage shortly after the plants are set out. Tobacco worms eat irregular pieces from the edges of the leaves and usually appear when the plants are about one month old. Grasshoppers usually damage tobacco plants late in the season, just before harvest. Cutworms and flea-beetles are also sometimes injurious to tobacco plants in seed-beds.

Cutworms

Cutworms are probably the most common and injurious of tobacco insects. They are the immature stages of noctuid, or owlet moths. As with many insects, they pass through four stages in their life-history, namely, moth, egg, larva (cutworm) and pupa. It takes about one year for most of these insects to go through their life cycle.

There are five kinds of cutworms found attacking tobacco. Two of them feed below the soil surface,[1] while three cut the stem or eat the leaves of the plant above the ground.[2] Most of the cutworm moths lay their eggs in grassy or weedy fields, but one of the most common kinds lays its eggs in cleanly cultivated, cropped land.[3] Since cutworm moth eggs are laid in cultivated as well as grassy or weedy fields, tobacco should not be planted in a field that was during the previous year under sod, grass, or weeds, as most likely it will contain many young cutworms as well as other insect larvæ, such as wireworms and webworms. The best control measure against cutworms is that of broadcasting a poisoned bran bait over the field in which tobacco is to be planted. Cutworms eat the poisoned bran readily if it is put out at the proper time.



Characteristic damage and behaviour of cutworms (after Gibson).

The bait referred to consists of bran, 25 pounds; Paris green, ½ pound; molasses, 1 quart; water, about 2½ gallons. It is prepared by mixing the bran and Paris green together, and the water and molasses together, and then combining the two mixtures. The whole should be stirred thoroughly. When ready for use, it should be crumbly so that it will slip readily through the fingers when broadcasting it over the field. The bait is applied at the rate of 15 to 25 pounds per acre at each application.

The first application is made one week before planting and the second five days later. The bait is applied in the evening, just before dusk. This time of the day is selected because the cutworms feed at night, and if the bait is applied earlier in the day the sun would dry it out considerably and it would not be as palatable to the larvæ. A warm evening should be selected for the treatment, as cutworms are more active at this time when the temperature is high. The bait is more effective if the field has been cultivated about two weeks before the date of application.

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[1] *Sidemia devastator* Brace and *Septis arctica* Bdv.

[2] *Euxoa messoria* Harr. *Feltia subgothica* Haw. and *Agrotis ypsilon* Rott.

[3] *Euxoa messoria* Harr.

If cutworms are troublesome in seed-beds, they should be sprayed with a solution of 1½-2 pounds of arsenate of lead in 40 gallons of water (approximately 4-7 teaspoonfuls per gallon), or dusted thoroughly with a dust consisting of one part of arsenate of lead to five parts of hydrated lime, or the poisoned bran bait, discussed above, should be broadcasted over the soil in the beds in the evening. Four pounds of bait are sufficient for about 100 square yards of bed. This bait can be used safely before the plants are up, or before they become very large. Care must be taken, however, to wash it off the leaves as Paris green may burn the tobacco foliage.

Wireworms

Wireworms are yellowish-brown, cylindrical, hard-shelled worms measuring when full-grown from ½ to ¾ inch in length. One common kind, however, found on tobacco, differs from this description being flat instead of cylindrical and very light yellow in colour with a conspicuous dark brown head.

Wire worms are the larvæ of the click or snapping beetles. About four kinds are commonly injurious. One of the most abundant in tobacco fields requires only one year to become mature,[4] while the other three spend about three years in the soil. The life-history of the latter is in general as follows: The beetles lay eggs from April to July and the larvæ hatching from these live in the soil for about three years. In the autumn of the third year, they pupate and turn into adults in the soil, remaining there until the next spring. Once the soil is infested, the wireworms will remain in it until they become mature one or more years later, depending upon the type of wireworm.

As click beetles lay eggs in sod, and grassy or weedy fields, it is best to avoid using such fields for a tobacco crop unless they have been examined thoroughly for wireworms and it has been determined that none are present.

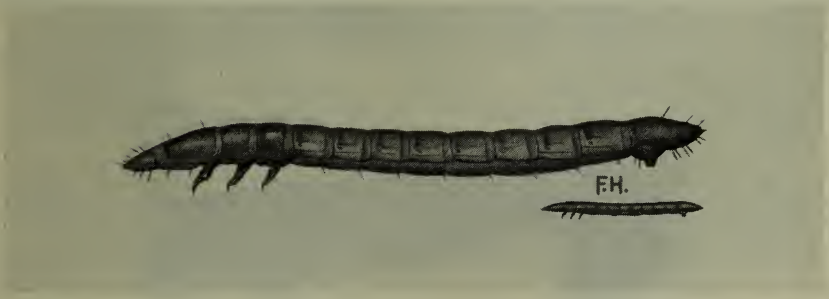
If the field has been in sod and is infested with certain kinds of wireworms the damage to the first crop planted is usually light. This is due, it is thought, to the fact that young wireworms feed on the decaying vegetation and roots still in the soil. By the second year most vegetative material has decayed and the wireworms have only the cultivated crop roots upon which to feed. The same is true for the third year, and under these conditions crop damage is greatest in the second and third year after breaking the land. In the case of the species which requires only one year to mature, the wireworms are fairly large at the time the first crop is planted and extensive damage is done. Infested fields should be planted to such crops as clover, soybeans or buckwheat, which will stand considerable wireworm injury.

In fields having slight wireworm infestation, any measure which will produce good plant growth such as strong seedlings, good field preparation, fertilizer, early and frequent cultivation should be utilized. These measures will not kill the wireworms, but they will enable the plant, in years of normal rainfall, to overcome injury to a considerable extent.

Replanting a portion of the crop is often necessary in order to obtain a good stand. Resets should be placed between the original plants, as wireworms will congregate around the plants of the first setting. This method can only be used satisfactorily when the fertilizer is broadcast.

[4] *Aeolus melillus* Say.

Typical injury to tobacco by wireworms (original).



General appearance of wireworm enlarged and natural size (after Gibson and Twinn).

Tobacco Worm

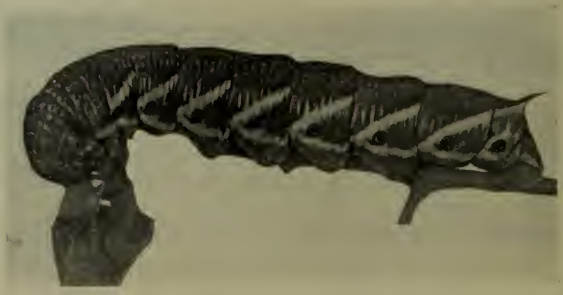
Phlegothontius quinquemaculata Haw.

The tobacco worm is one of the most common pests of tobacco in Ontario and the crop must be sprayed or dusted for its control every year. In Quebec, however, it is unimportant.

The adult, known as the five-spotted sphinx, is a fairly large greyish-brown hawk moth, having a wing spread of about 4 inches. The moths fly only at night and may frequently be seen in the tobacco field or feeding on blossoms of petunias, jimson weed and other *Nicotiana* species.

The moths appear each season about the end of the first week in July. They begin laying eggs on the tobacco foliage and continue this activity until about August 7. The eggs are laid usually on the under surface of leaves and hatch into the caterpillar stage in four to five days. When mature the caterpillar drops to the ground and burrows into the soil, where it forms the pupal stage. The winter is passed in the pupal stage in the soil.

Burley tobacco plant showing damage by tobacco worm (original).

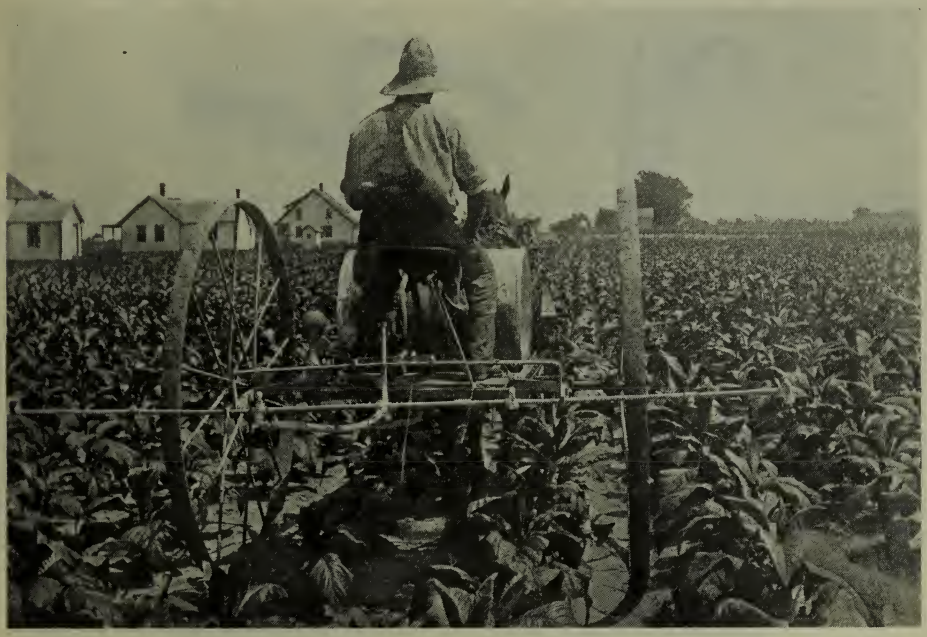


Full grown tobacco worm (after Dustan).

The tobacco worm may be controlled by spraying the plants with a solution of 3 to 4 pounds of arsenate of lead to 40 gallons of water. Spraying should be done as soon as the caterpillars appear on the leaves. In years when the insect is particularly abundant, a second spraying with the same solution may be necessary.

Some growers prefer to use a dust application consisting of 3 to 5 pounds arsenate of lead and 9 to 15 pounds of hydrated lime (three times the amount

of hydrated lime as of arsenate of lead). Dusts are applied when the plants are covered with dew so that the maximum amount of dust will adhere to the foliage. The ideal time to make applications is during a calm early morning when the dew is still on the plants. It is more likely that dust applications will have to be repeated in order to control the caterpillars as dusts do not remain on the foliage as long as liquid applications. This is especially so in rainy weather.



Spraying is the only means of controlling the tobacco worm.

Tobacco Stalk Borer or Tobacco Webworm

Crambus spp.

In Ontario, these insects have occasioned considerable losses in certain years. The stalk borer commences to damage plants just after they are transplanted, continuing to feed and causing damage until the last week in June. The damage resembles that caused by wireworms. The larvæ, however, resemble small cutworms. They are soft in texture and of a dull greyish or greenish colour. They make a silken case in the soil near the base of the plant in which they live when not feeding.

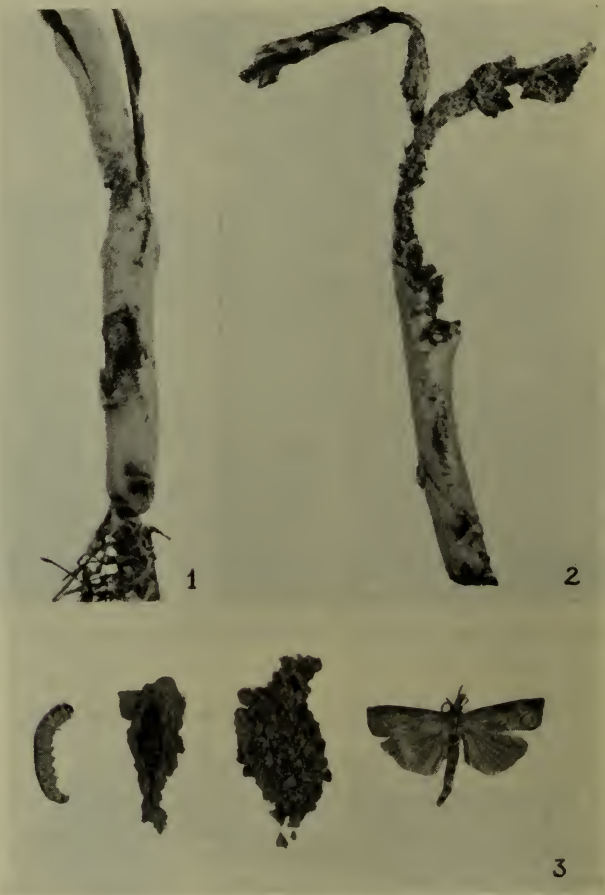
Stalk borers are the larvæ of moths which lay eggs in sod, and grassy or weedy fields from the first week in June to the first week in August. Since the eggs are laid in such fields, their use for tobacco should be avoided. Much can be done to help the plant overcome slight injury by the strict adherence to good cultural practices such as good field preparation, proper fertilization, the planting of vigorous, strong plants, and early and frequent cultivation.

Replanting is often necessary and the resets should be placed between the original plants. This method can only be used satisfactorily when the fertilizer has been broadcast.

There is no insecticide treatment or poisoned bait that will aid in the slightest degree in the control of these worms.

Flea-Beetles

Flea-beetles are hard-shelled, very active insects about $\frac{1}{8}$ inch in length In colour, they are black, brown, or striped. They hop like fleas, a character from which they derive their name. Injury is caused by eating small circular or angular holes in the leaves. In the field, flea-beetles cause damage sometimes just after plants are set out, the plants around the edges often being severely injured. These beetles spend the winter under leaves, plant debris, around edges of, and even in the fields if any refuse has been left. All such



(1) and (2) tobacco seedlings injured by stalk borer; (3) stages of stalk borer—larva, pupa, larval case and adult (after Dustan).

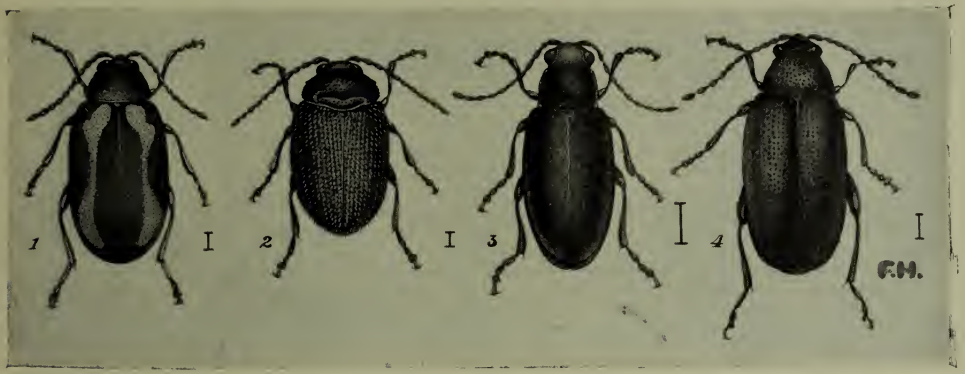
places should be cleaned by burning the refuse, or by similar means, early in the spring. After the beetles migrate to the plants, they may be controlled by spraying with a solution of at least 2 pounds arsenate of lead to 40 gallons of water. Great care should be taken to spray both the upper and lower surfaces of the leaves.

In the seed-beds, the plants may be sprayed with the same solution as indicated above for field use (in small quantities approximately 4-7 teaspoonfuls per gallon), or the beds may be dusted thoroughly with a dust consisting of one part arsenate of lead to five parts hydrated lime. The applications are made as soon as the insect or injury is noted, and repeated if necessary. Tightly constructed beds will make it more difficult for flea-beetles to enter.

Grasshoppers

Grasshoppers are sometimes injurious to tobacco. They riddle the leaves and in some cases completely strip them. Usually the damage is done late in the season about harvest time. These insects breed in old sod areas, wood lots and roadsides and when tobacco is planted near such sites, during a year when grasshoppers are abundant, it is usually damaged.

Grasshoppers may be controlled by the use of poisoned bran bait scattered, during a warm day, in the tobacco field and in grasshopper breeding grounds. The bait is made up as follows: bran, 25 pounds; Paris green, 1 pound; salt, 1 pound; water, about $2\frac{1}{2}$ gallons. If sawdust is available use half bran and half sawdust in the mixture. Mix the bran, Paris green and salt together and then gradually add the water until the mixture is of the correct consistency to crumble and fall readily through the fingers.



Representative appearance of flea beetles: (1) striped flea beetle; (2) potato flea beetle; (3) red-headed flea beetle; (4) cabbage flea beetle (after Gibson).

The bait is distributed thinly over the ground at the rate of about 10 to 15 pounds per acre. The mixture should be broadcast among the grasshoppers, if possible, in order that they may eat it at once. The bait should be distributed on a bright day between ten and eleven o'clock a.m. The temperature in the shade should range between 70°F. and 85°F. It is usually useless to put the bait out during a cool or excessively warm day.

In certain areas, where grasshoppers are a frequent pest, a barrier consisting of a few rows of corn planted around the tobacco field may help to confine the grasshoppers to this crop and thus reduce the numbers which would otherwise find their way to the tobacco.

ACKNOWLEDGMENTS

The support and assistance of those engaged in tobacco investigation under the Dominion Experimental Farms Branch is gratefully acknowledged. The advice and suggestions contributed by Messrs. R. J. Haslam and O. G. Williams of the Dominion Experimental Station at Harrow have been particularly valuable. Thanks are due, also, to Dr. N. T. Nelson and Mr. T. G. Major, who read the manuscript and made a number of helpful suggestions.

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